ASEA BROWN BOVERI

NAS Jacksonville Administrative Record
Document Index Number

32212-000
23.11.00.0025

November 11, 1994

Southern Division
Naval Facilities Engineering Command
ATTN: Mr. Dana Gaskins, Code 1857
2155 Eagle Drive, P.O. Box 190010
North Charleston, South Carolina 29419-9010

Subject: Source Reduction Remediation Goals for the Preliminary Economic Evaluation Report, Old Plating Shop, NAS JAX

Dear Dana:

Please find enclosed ABB's evaluation of soil reduction remediation goals for contaminated soils beneath the Old Plating Shop. The memo presents the methods used to calculate and evaluate soil clean up levels with regards to varying risk levels ranging from 10^{-4} to 10^{-6}. The intent of the memo is to evaluate source reduction with regards to supporting a more quantitative evaluation of residual risks during the RI/FS for OU-3. A primary factor in the evaluation was comparing the proposed excavations required for each source reduction scenario against the concrete slab removal proposed for the Old Plating Shop demolition (i.e. evaluating the economics and logistics of excavating additional concrete and soil versus the risk reduction gained).

The memo presents areal extent of excavations to meet risk reductions of 10^{-4}, 10^{-5}, and 10^{-6}. The excavations range from approximately 3500 yrd^3 (for 10^{-6} and 10^{-5} risk levels) to 700 yrd^3 (for 10^{-4} risk level). These estimates assume the excavations would average a three foot depth. Additionally, if a cost of \$130/yrd^3 is assumed to be representative for transportation and disposal of the excavated material to a hazardous waste landfill, the excavations represent cost from \$455,000 to \$91,000 (\$130/yrd3 was the average cost used for the focused FS at OU-2).

Considering the intent of the source reduction action for the Old Plating Shop, it is recommended that contaminated soils be removed from beneath the Old Plating Shop concrete slab that will result in residual soil concentrations that are protective to groundwater to a 10^{-4} risk level. Results of Southern Divisions evaluation and selection will be incorporated into the Preliminary Economic Evaluation Report (PEER) that will be incorporated into the CERCLA record for the site under the "Time Critical" path the Navy is following for this interim action.

Should you have any question regarding this matter, please do not hesitate to call Peter Redfern or me at (904) 269-7012.

Very truly yours,
ABB ENVIRONMENTAL SERVICES, INC.

Jesse M. Tremaine
Senior Scientist

cc: Peter Redfern
File

Introduction

The interim source reduction action objective for the plating shop is to reduce the contamination in the soil underlying the concrete slab of the Old Plating Shop, thereby reducing the potential for degradation of groundwater quality. The reduction action addressed in this memo is not intended to be the final action at the site, but is an opportunistic action taken as part of the demolition of the above grade structure and portions of the concrete slab at the Old Plating Shop located in Building 101. This area will be further investigated during the overall RI/FS under CERCLA for OU3.

This memorandum presents potential interim soil remediation levels of organic and inorganic constituents that are protective of groundwater. These levels were calculated based on an acceptable cancer risk of 1×10^{-6}, 1×10^{-5} or 1×10^{-4}, or a noncancer hazard quotient of 0.1, 1.0 or 10. Potential contamination of groundwater from soil is the only route of exposure considered, because upon completion of the demolition activities this site will be capped by construction of a new concrete slab and building, thus preventing receptor contact with soil.

Method

Soil samples collected from the plating shop (Ensearch 1994 remediation) were analyzed for the Target Analyte List (TAL) inorganics and Target Compound List (TCL) organics. The maximum concentration for each analyte detected at the Old Plating Shop was compared with the proposed USEPA soil screening levels (SSLs) protective of groundwater. If the concentration detected onsite exceeded the SSL or if there was no analyte-specific SSL available, calculation of a site-specific soil clean-up level protective of groundwater was considered. Other soil concentrations considered as screening levels were soil clean-up levels goals based on leachability developed by the State of Florida (FDEP, 1994), and the maximum concentration of contaminants in TCLP leachate (USEPA, 1993), assuming a 20-fold dilution from soil to leachate. The State of Florida has not derived SSLs for inorganics, but defers to TCLP values. The TCLP values were developed to characterize solid waste relative to land disposal, and are not designed to be protective of human health. Since the goal of this memorandum is to develop source removal recommendations that are protective of human health, the Florida and TCLP screening levels were considered inconsistent with these objectives, and were not used in this evaluation.

Table 1 summarizes the maximum concentration of analytes found onsite and the proposed USEPA screening levels. Based on comparison to the SSLs, potential contamination of groundwater from compounds in soil was considered for constituents with "Yes" in the "Retained" column. Analytes detected for which there were no SSLs, were also retained for further consideration.

The USEPA (1994a) equation presented in Table 2 was used to calculate soil clean-up levels protective of human health associated with ingestion of groundwater. This equilibrium soil/water partition equation describes the ability of contaminants to sorb to organic carbon in soil (Dragun, 1988). It has been adjusted to relate a sorbed concentration in soil to the analytically measured total soil concentration. In the equation, the movement of organic constituents through soil is characterized using the content of organic carbon in soil (foc) and an organic carbon/water partition coefficient (Koc). The mobility of inorganics in soil is more complex and is affected by a number of parameters, most significantly pH. The clean-up levels for inorganics were derived using the equation in Table 2, however inorganic-specific Kd values, modeled over a range of soil pH values (4.9, 6.8, and 8.0) identified by the USEPA (1994b), were used in the equation in place of the Koc x foc parameters. In lieu of site-specific values, non-analyte specific parameters used in the equation are USEPA (1994a) default values.

Table 1
Comparison of Maximum Concentration Detected On-site to Soil Screening Levels Considered Protective of Groundwater

Analytes	Maximum Concentration	USEPA SSL DAF = 10 [1]	Retained?
Metals (mg/kg)			
Aluminum	9550		Yes
Arsenic	3.7	15	No
Cadmium	334	6	Yes
Calcium	31400		No[2]
Chromium	2940	19	Yes
Cobalt	104		Yes
Copper	311		Yes
Iron	16000		No[2]
Lead	442		Yes
Magnesium	2330		No[2]
Manganese	113		Yes
Mercury	0.91	3	No
Nickel	90	21	Yes
Selenium	2.7	3	No
Silver	118		Yes
Thallium	5.5	0.4	Yes
Vanadium	18.1		Yes
Zinc	297	42000	No
Cyanide (mg/kg)	10.2		Yes
Volatile Organic Compounds (mg/kg)			
Acetone	0.2	8	No
2-Butanone	0.018		Yes
Chlorobenzene	0.026	0.6	No
Chloromethane	0.053		Yes
1,2 Dichloroethene	0.017	0.2	No
Ethylbenzene	0.095	5	No
4-Methyl-2-Pentanone	0.053		Yes
Toluene	0.052	5	No
Trichloroethene	0.11	0.02	Yes
Xylene (total)	0.37	74	No

See notes at end of table.

Table 1 (Cont.)
Comparison of Maximum Concentration Detected On-site to Soil Screening Levels Considered Protective of Groundwater

Analytes	Maximum Concentration	USEPA SSL DAF = 10	Retained?
Semi-Volatile Organic Compounds (mg/kg)			
Acenaphthene	0.27	200	No
Anthracene	0.31	4300	No
Benzo (a) anthracene	1.8	0.7	Yes
Benzo (a) pyrene	1.7	4	No
Benzo (b) fluoranthene	2.9	4	No
Benzo (g h i) perylene	1.1		Yes
bis (2-ethylhexyl) phthalate	7	11	No
Butylbenzylphthalate	1.4	68	No
Carbazole	0.49	0.5	No
Chrysene	2.8	1	Yes
Di-n-octyl Phthalate	1.4	14000000	No
Dibenzofuran	0.12		Yes
1,2-Dichlorobenzene	1.3	6	No
Fluoranthene	4.2	980	No
Fluorene	0.16	160	No
Indeno (1 2 3-cd) pyrene	1.2	35	No
Phenanthrene	2.6		Yes
Pyrene	2.9	1400	No

1 DAF = Dilution/Attenuation Factor
2 These compounds are considered essential nutrients and are not considered for soil clean-up.

The target soil leachate concentrations for inorganics and organics are based on acceptable health-based concentrations associated with cancer risk of 1×10^{-6}, 1×10^{-5} or 1×10^{-4}, or a noncancer hazard quotient of 0.1, 1.0 or 10, assuming ingestion of groundwater by an adult as described in RAGS (USEPA, 1989). The one exception to this is the target soil leachate concentration for copper, which is based on the maximum contaminant concentration goal (MCLG) because there is inadequate information for the calculation of a reference dose. Based on the average (arithmetic mean) site-specific pH of 7.8, the Kd values for a pH of 8.0 (USEPA, 1994b) were used to calculate soil clean-up levels for inorganics. Chemical specific Kocs and Henry's Law Constants for organics are from the literature.

Results

Presented in Tables 3 and 4 are potential interim soil remediation levels, considered to be protective of groundwater. These clean-up levels are calculated based on concentrations associated with acceptable cancer risks of 1×10^{-6}, 1×10^{-5} or 1×10^{-4}, or noncancer hazard quotients of 0.1, 1.0 or 10. These levels of risk were chosen because they are indicative of an acceptable level of exposure as defined in the National Contingency Plan (USEPA, 1990). In addition, a cancer risk of 1×10^{-6} or less is considered to be *de minimis*. The range of noncancer hazard quotients chosen are centered around one, a value generally considered to be without deleterious effects, even for sensitive individuals. These interim clean-up levels are sufficient to reduce the potential impact to groundwater from soil, however, further consideration of potential risks and hazards will be addressed in the OU-3 RI/FS.

Table 2
Soil Clean-up Level Partitioning Equation for Migration to Ground Water

$$Soil\ Clean\text{-}up\ Level\ (mg/kg) = C_w\,[K_D + \frac{(\theta_w + \theta_a H')}{\rho_b}]$$

Parameter	Definition	Default	Reference or Equation
C_w	Target soil leachate concentration	Chemical specific (mg/L)	Calculated
K_d	Soil-water partition coefficient	Chemical specific (L/kg)	$K_{oc} \times f_{oc}$ for organics Inorganic-specific K_d
K_{oc}	Soil organic carbon/water partition coefficient	Chemical specific (L/kg)	
f_{oc}	Fraction organic carbon in soil	0.2% (0.002 g/g)	USEPA, 1994a
θ_w	Water-filled soil porosity	0.3	$w \times \rho_b$
w	Average Soil Moisture content	20% (0.2 kg_{water}/kg_{soil})	USEPA, 1994a
ρ_b	Dry soil bulk density	1.5 (kg/L)	$(1\text{-}n) \times \rho_s$
n	Soil porosity	0.43 (L_{pore}/L_{soil})	USEPA, 1994a
ρ_s	Soil particle density	2.65 (kg/L)	USEPA, 1994a
θ_a	Air-filled soil porosity	0.13 (L_{air}/L_{soil})	$n - \theta_w$
H	Henry's Law Constant	Chemical specific (atm·m³/mol)	
H'	Henry's Law Constant	Unitless	H x 41, where 41 is a units conversion factor

Please note, the following analytes, copper, lead, 2-butanone, chloromethane, and 4-methyl-2-pentanone, had interim soil remediation levels protective of groundwater calculated because there were no analyte-specific SSLs available for comparison.

The objective of this memo is not to include the quantitative assessment of analytes for which there is inadequate data. This aspect of the risk assessment will be considered as part of the more inclusive RI/FS report prepared under CERCLA for OU3. As a result of this action, soil clean-up levels were not calculated for the following analytes because of the lack of quantitative information to assess partitioning of inorganics in soil:

- aluminum
- cobalt
- manganese
- silver
- vanadium
- cyanide

Additionally, no soil clean-up levels were calculated for benzo(g,h,i) perylene, dibenzofuran or phenanthrene because adequate quantitative toxicity information is not available.

Table 3 Site-Specific Clean-up Levels Protective of Groundwater Based on an Acceptable Range of Cancer Risks				
Compound	Maximum Concentration	1×10^{-6}	1×10^{-5}	1×10^{-4}
Volatile Organic Compounds (mg/kg)				
Trichloroethane	0.11	0.00374	0.0374	0.374
Semi-Volatile Organic Compounds (mg/kg)				
Benzo(a)anthracene	1.8	0.322	3.22	32.2
Chrysene	2.8	0.467	4.67	46.7

Table 4 Site-Specific Clean-up Remediation Levels Protective of Groundwater Based on a Range of Noncancer Hazard Quotients				
Compound	Maximum Concentration	0.1	1	10
Metals (mg/kg)[1]				
Cadmium	334	8.21	82.1	821
Chromium (hexavalent)	2940	0.259	2.59	25.9
Copper	311		37100 [2]	
Lead	442	400 [3]	400 [3]	400 [3]
Nickel	90	10.5	105	1050
Thallium	5.5	0.0281	0.281	2.81
Volatile Organic Compounds (mg/kg)				
2-Butanone	0.018	0.458	4.58	45.8
Chloromethane	0.053	0.00617	0.0617	0.617
4-Methyl-2-Pentanone	0.053	0.0696	0.696	6.96

1 Kd values were available for the following metals: Arsenic, Barium, Beryllium, Cadmium, Chromium (hexavalent), Copper, Mercury, Nickel, Selenium, Thallium, and Zinc (USEPA 1994b).
2 For copper, a soil clean up level was proposed using the MCLG of 1.3 mg/L.
3 USEPA Office of Solid Waste and Emergency Response (OSWER) Directive #9355.4-12, dated July 14, 1994 Interim recommended soil cleanup level at Superfund sites for residential settings.

The equation used to calculate the interim soil remediation levels relates concentrations of contaminants adsorbed to soil organic carbon to soil leachate concentrations in the unsaturated zone. Contaminant migration through the unsaturated zone to the water table and ground water transport in the saturated zone generally reduces the soil leachate concentration. To account for this reduction a DAF or dilution/attenuation factor is applied. The values presented in Tables 3 and 4 are reported assuming there is no attenuation or dilution of the contaminant (i.e., the concentration at the receptor point is equal to the concentration in soil leachate as it leaves the source). A USEPA (1994a) default value of 10, determined by weight of evidence, can be applied, or site-specific value can be calculated using the following mixing zone equation. Application of this DAF will reduce the amount of clean-up necessary at the plating facility.

Maximum concentrations of chromium, cadmium, and thallium were evaluated with regard to soil volumes that would need to be removed depending on the level of protectiveness selected. Interim remediation, based upon these maximum concentrations, would also encompass all other contaminants that would require removal under the different protectiveness scenarios.

Figure 1 illustrates the proposed area of concrete to be removed and the concentrations of chromium, cadmium, and thallium which represent maximum concentrations for these metals at depths ranging from 0-18" to 3-24" below land surface. When these concentrations are evaluated with respects to the varying proposed interim soil remediation levels for the three hazard index of 0.1, 1.0, and 10 (representing risk equal to 10^{-6} to 10^{-4}) the areal extent of soil removal changes significantly.

Figure 2 illustrates the areal extent of soils that would require removal under the three protectiveness scenarios. As indicated by Figure 2, removing soil to the 0.1 and 1.0 hazard index (equal to 10^{-6} and 10^{-5} risk) would require excavation outside the proposed area for concrete removal to the boundary of the soil samples collected. Interim soil remediation to the 10 hazard index (equal to 10^{-4} risk) approximates the proposed concrete removal area and would be supportive of the objective to reduce source contamination for protectiveness of groundwater quality with quantitative evaluation of residual risks being conducted during the RI/FS for OU-3.

Uncertainty

The conceptual model used by the USEPA to develop the guidance used in this memo, is protective for a source area of up to 30 acres. The model also assumes an infinite source, and that the source extends to the water table. Attenuation in the unsaturated zone is not considered, however dilution is assumed within the aquifer to the point of compliance at the edge of the site by applying a default DAF of 10. Because the source being considered here is much smaller than the 30 acres assumed by the USEPA, the default DAF of 10 may be an underestimation of dilution/attenuation. Although, since the area will be capped, the infiltration rate considered in the derivation of the DAF may be small and the default DAF of 10 could be an overestimation. The derivation of a site specific dilution/attenuation factor is recommended, however at this time site-specific values are unavailable.

For the derivation of inorganic soil clean-up levels, Kds modeled for a soil pH of 8.0 were used. For comparative purposes, Table 5 presents soil clean-up levels for hazard quotients of 0.1, 1.0 and 10, calculated using the USEPA Kds modeled for soil pH levels of 6.8 and 8.0 (USEPA, 1994b). Site-specific average pH is 7.8. Comparison of these values indicate that the only metal to be added by a lower site pH would be nickel. However, using the maximum values detected for the various depths for chromium, cadmium, and thallium for remediation extent would encompass nickel contaminated soils.

Table 5
Site-Specific Interim Remediation Levels Protective of Groundwater Based on pH Specific Kds

Compound	Maximum Concentration	HI = 0.1		HI = 1		HI = 10	
		pH 6.8	pH 8.0	pH 6.8	pH 8.0	pH 6.8	pH 8.0
Metals (mg/kg)							
Cadmium	334	0.219	8.2	2.19	82.4	21.9	824
Chromium (hexavalent)	2940	0.35	0.259	3.5	2.59	35	25.9
Copper [1]	311	NC	NC	13000	37100	NC	NC
Nickel	90	1.55	10.5	15.5	105	155	1050
Thallium	5.5	0.0208	0.0281	0.208	0.281	2.08	2.81

[1] For copper, a soil clean up level was proposed using the MCL of 1.3 mg/L. NC = not calculated.

It should be noted that the methodology used here has been used by the State of Florida to develop soil clean-up goals based on leachability, however it is still under review by the USEPA. The Kd's proposed for use with the inorganic compounds were submitted for general review in July, along with the soil/water partition equation. This guidance is being used by the USEPA on a pilot basis for remedial investigation/feasibility studies.

References

Dragun, J. 1988. The Soil Chemistry of Hazardous Materials. Hazardous Materials Control Research Institute, Silver Spring, MD.

FDEP. 1994. Memo from Ligia Mora-Applegate to Tim Bahr. RE: Cleanup Goals for the Military Sites in Florida dated July 5, 1994.

USEPA. 1989. Risk Assessment Guidance for Superfund, Volume 1 Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.

USEPA. 1990. National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule. 40 CFR Part 300. Federal Register, 55(46):8718.

USEPA. 1993. 40 CFR 261.

USEPA. 1994a. Draft Guidance for Soil Screening Level Framework. Office of Waste and Emergency Response.

USEPA. 1994b. Technical Background Document for Draft Soil Screening Level Framework: Review Draft. Office of Solid Waste and Emergency Response.

NAS-JAX Plating Shop

Ebasco Environmental

Contract Number N47408-92-D-3059

Soil Sampling Locations

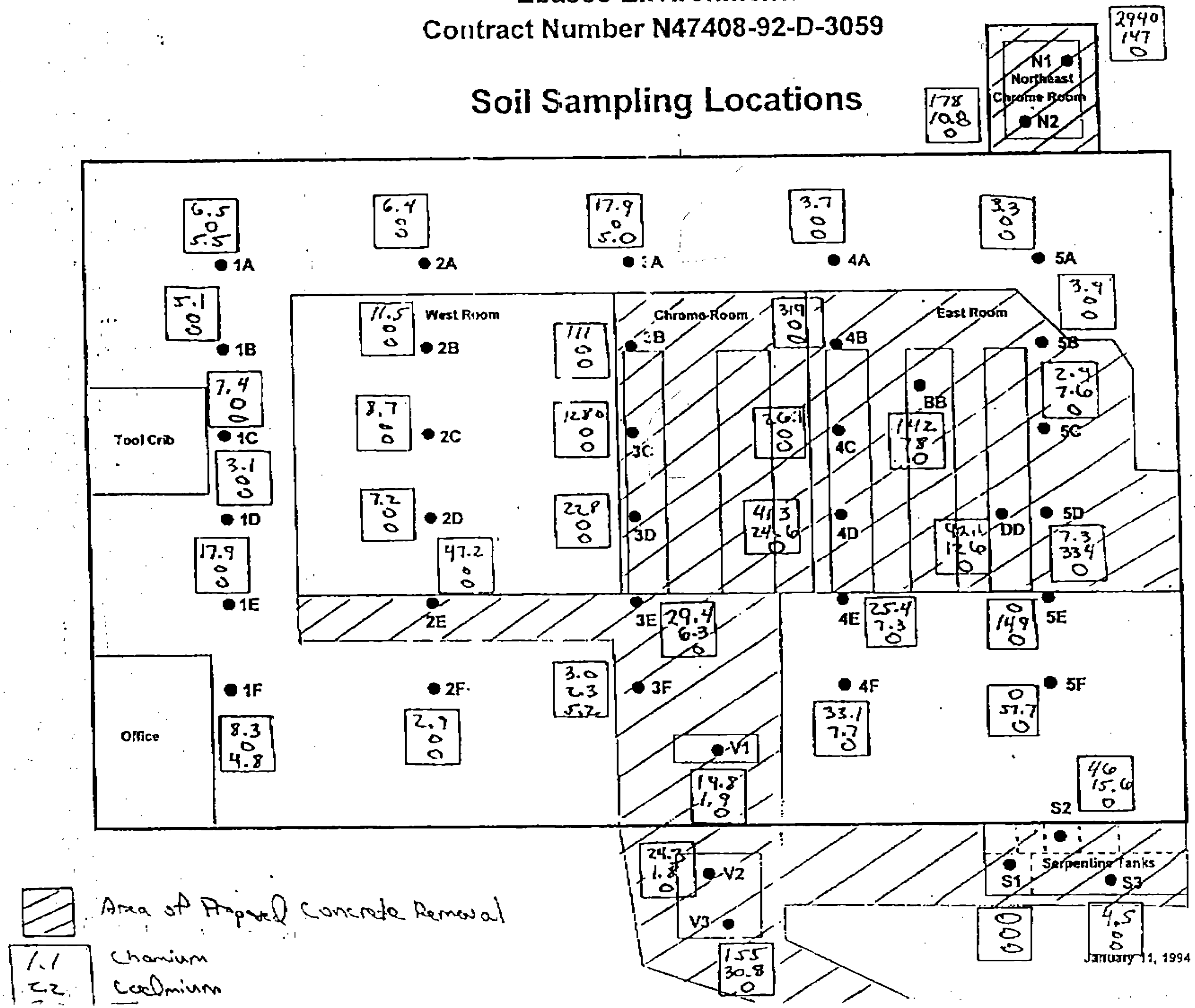

Figure 1

NAS-JAX Plating Shop
Ebasco Environmental
Contract Number N47408-92-D-3059

Soil Sampling Locations

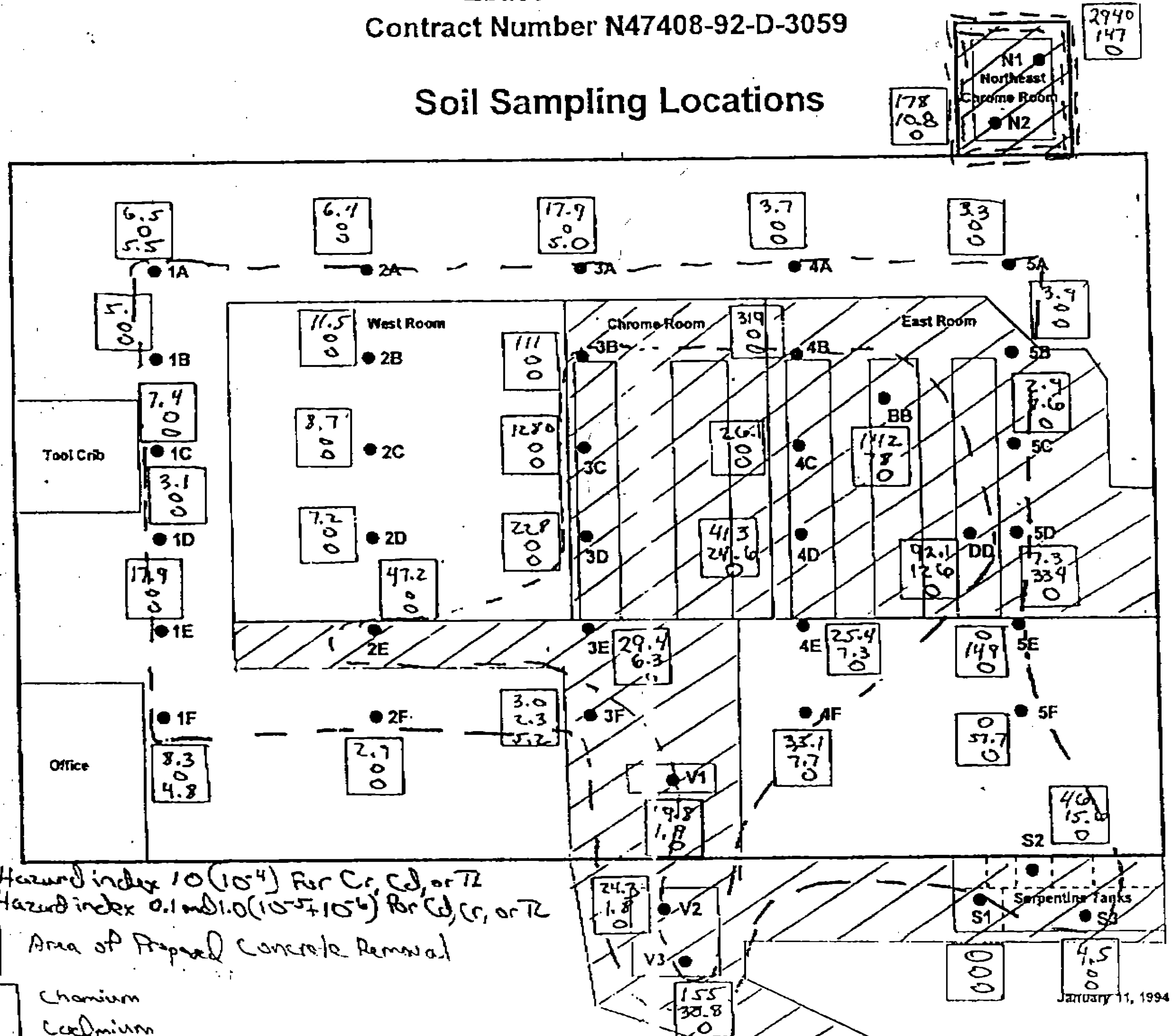

Figure 2

– – – Hazard index 10 (10⁻⁴) For Cr, Cd, or Tl
— — — Hazard index 0.1 and 1.0 (10⁻⁵ + 10⁻⁶) for Cd, Cr, or Tl

Area of Proposed Concrete Removal

1.1 Chromium
2.2 Cadmium

NAS-JAX Plating Shop
Ebasco Environmental
Contract Number N47408-92-D-3059

Soil Sampling Results

	1A-1	1A-2	1A-3	2A-1	2A-2	2A-3	3A-1	3A-2	3A-3	4A-1	4A-2	4A-3	5A-1	5A-2	5A-3	1B-1	1B-2	1B-3
Metals (mg/kg)																		
Aluminum	3,520	497	123	1,860/2,830	346	119	3,120	2,210	780	470	407	58.2	1,440	334	955/893	1,220	2,090	126
Calcium	1,360			1,160/1,180			3,070		1,740						1,770/1,940	1,330	2,380	
Chromium	6.5			4.8/6.4			6.5	3.6	17.9		3.7		3.3			3.0	5.1	
Iron	4,050	482	144	2,520/3,320	504	241	2,230	811	575	547	417	178	1,530	443	1,680/2,010	1,950	3,160	158
Lead	6.5	0.76	1.5	4.0/4.4	0.74	1.4	4.8	2.0	2.3	2.3	2.1		5.4	1.0	7.4/7.6	4.1	4.2	1.6
Manganese	19.1		6.8	14.6/18.1	3.2	8.1	23.3	14.3	4.0		5.5		9.6	3.5	20.0/22.7	11.9	14.2	11.1
Mercury			0.13												0.30/0.04			
Selenium		2.7					2.4											
Thallium		5.5					5.0											
Zinc	6.7			4.9/5.6			6.1								8.0/6.9	9.3	10.5	8.0
pH	7.65	4.40	6.90	8.45/8.35	5.35	7.30	8.80	8.05	7.80	8.50	8.20	7.30	9.10	8.10	6.00/6.30	8.45	3.65	6.60
Cyanide (mg/kg)																		
Volatile Organic Compounds (mg/kg)																		
Acetone	0.140			0.024/0.053									0.061	0.016	0.056/0.020 (0.041/0.047)	0.065		
4-Methyl-2-Pentanone														0.015				
Toluene															ND/ND (ND/0.015)			
Semi-Volatile Organic Compounds (mg/kg)																		
Butylbenzylphthalate	0.700																	
Fluoranthene													0.830					
Pyrene													0.640					
Chrysene													0.440					
Benzo (b) fluoranthene													0.500					

NAS-JAX Plating Shop
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Contract Number N47408-92-D-3059

Soil Sampling Results

	2B-1	2B-2	2B-3	3B-1	3B-2	3B-3	4B-1	4B-2	4B-3	5B-1	5B-2	5B-3	1C-1	1C-2	1C-3	2C-1	2C-2	2C-3
Metals (mg/kg)																		
Aluminum	3,850		94.6	592	234	104/178	4,750	182	169	511	181	1,970	3,500	222	149	1,120/639	279	65.4
Calcium	1,570									2,350			1,920					
Chromium	7.7		11.5		8.4	96.2/111	75.9	4.2	319			3.9	7.4			2.9/ND		8.7
Copper										7.8								
Iron	4,260	576	110	833	407	129/249	13,500	340	202	995	283	1,980	6,940	396	156	1,590/962	458	106
Lead	5.0	1.0	1.3	5.0	10.1	1.1/1.2	3.1	2.1	1.8	4.3		2.7	5.3	0.8	1.3	2.0/1.6	8.2	1.7
Manganese	28.1		8.7	7.3		10.4/12.2	5.3		6.1	7.5		11.5	17.6		7.5	9.6/7.4		11.4
Mercury										0.44								
Vanadium							18.1						11.5					
Zinc	9.4				4.6			6.3	5.9			9.3	9.6			ND/4.7		
pH	8.30	4.90	5.95	8.20	7.50	6.60/6.95	7.40	7.35	6.30	8.85	7.55	5.90	8.20	5.45	6.60	9.15/8.90	6.05	5.55
Cyanide (mg/kg)																		
Volatile Organic Compounds (mg/kg)																		
Acetone				0.058								0.017				ND/0.018		
Chloromethane				0.053			0.018											
Semi-Volatile Organic Compounds (mg/kg)																		
Benzo (b) fluoranthene																0.410/ND		

NAS-JAX Plating Shop
Ebasco Environmental
Contract Number N47408-92-D-3059

Soil Sampling Results

	3C-1	3C-2	3C-3	4C-1	4C-2	5C-1	5C-2	1D-1	1D-2	1D-3	2D-1	2D-2	2D-3	3D-1	3D-2	3D-3	4D-1	4D-2
Metals (mg/kg)																		
Aluminum	654	1,620	6,980	1,040	1,830	479	1,750/2,020	1,090	251	58.7	3,450	264	124	145	82.9	718/783	596	723
Arsenic											2.5							
Cadmium						1.5	6.8/7.6										6.1	24.6
Calcium	2,570			1,750		6,980					2,830			5,070				
Chromium	742	1,280	246	26.1	3.1	2.9		3.1			7.2		7.1	228	92.5	6.0/4.9	69.4	413
Cobalt				40.3										104				
Copper				65.1										15.0			19.4	10.8
Iron	1,320	790	6,180	16,000	1,310	469	584/673	2,000	367	158	5,220	359	208	4,480	275	576/572	569	898
Lead	22.2	1.5	7.8	5.6	3.6	2.5	2.1/2.3	2.3	2.1	0.8	5.9	2.1	1.2	117	1.3	2.7/2.9	24.3	76.7
Manganese	7.4		5.4	70.8	5.5	6.6		7.2		10.9	26.9		6.4	24.8			5.2	8.6
Nickel				19.2													29.6	21.6
Silver				17.5										4.8			3.0	10.3
Vanadium			17.1															
Zinc				9.4		5.2					12.7	4.2		11.7			6.3	11.1
pH	9.70	7.40	6.65	8.80	6.90	12.30	7.20/6.85	8.80	4.85	5.35	8.50	5.55	6.75	11.10	7.70	7.35/7.30	11.30	9.70
Cyanide (mg/kg)			2.7				1.6/2.8							1.5				
Volatile Organic Compounds (mg/kg)																		
Acetone	0.042	0.038		0.029	0.063	0.200	0.040/0.029	0.027			0.016			0.110		0.024/0.068	0.033	0.035
4-Methyl-2-Pentanone						0.017												
Toluene				0.014														
Trichloroethene	0.110															ND/0.049		
Xylene (total)	0.059			0.034										0.028		ND/0.064		
1,2 Dichloroethene																	0.045	0.017
Semi-Volatile Organic Compounds (mg/kg)																		

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Butylbenzylphthalate	1.400																	
Benzo (a) Pyrene				1.000 (1.700)	0.690 (0.930)													

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Soil Sampling Results

	5D-1	5D-2	5D-3	1E-1	1E-2	1E-3	2E-1	2E-2	2E-3	3E-1	3E-2	3E-3	4E-1	4E-2	4E-3	5E-1	5E-2	5E-3
Metals (mg/kg)																		
Aluminum	1,820	167	356	2,450	9,550	865	1,040/383	161	731	2,730	1,520	1,510	343	185	96.2	449	112/183	456
Arsenic					3.5													
Cadmium	334	62.0	43.8							3.7	5.1	6.3		1.3	7.3		14.9/14.0	149
Calcium	16,800			3,560	3,930	1,380	1,410/1,130			60,500	24,500	26,700						
Chromium	7.3		2.5	5.0	17.9		10.5/47.2	4.7	5.1	10.2	29.4	19.9			25.4			
Copper	311	58.6	80.0								7.1						6.8/7.1	
Iron	2,430	318	2,150	2,340	11,200	1,010	3,180/737	501	1,420	1,410	1,460	1,440	608	398	99.6	683	312/356	452
Lead	8.3	1.4	1.5	4.0	7.6	6.6	3.5/1.9	9.0	4.8	61.9	75.4	83.0	1.4		2.3	1.5	0.52/0.65	1.8
Magnesium					1,940					2,330								
Manganese	16.1		17.9	15.9	99.2	7.5	17.0/5.2		6.9	91.8	37.9	36.0	3.7		4.2	5.5		15.3
Mercury			0.34							0.08		0.06						
Nickel	54.2	18.2	58.4			17.3			33.3									
Vanadium					17.8													
Zinc	33.0	14.8		8.7	22.9	10.0	25.7/11.0	5.0	5.4	71.0	40.3	66.0						
pH	8.50	8.30	7.55	8.20	6.50	4.30	8.50/8.85	7.80	5.20	8.40	8.40	8.40	8.40	8.60	8.30	8.90	8.90/8.85	7.40
Cyanide (mg/kg)	10.2	2.3	8.1															
Volatile Organic Compounds (mg/kg)																		
Acetone									0.017		0.023	0.014		0.020				
Toluene																		0.024
Semi-Volatile Organic Compounds (mg/kg)																		
bis (2-ethylhexyl) Phthalate																1.800		

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	1F-1	1F-2	1F-3	2F-1	2F-2	2F-3	3F-1	3F-2	3F-3	4F-1	4F-2	4F-3	5F-1	5F-2	5F-3	BB-1	DD-1
Metals (mg/kg)																	
Aluminum	3,900	309	2,030	1,100	230	139	944	523	403/599	737	200	2,240	371	154	275	126	248
Cadmium							2.3					7.7			57.7	78.0	126
Calcium	3,970			2,570			7,890										
Chromium	8.3		4.9	2.9			3.0			2.7	3.2	33.1				142	92.1
Cobalt				20.8													
Copper				5.4												78.4	59.3
Iron	4,400	547	2,240	2,350	415	205	1,580	597	391/595	911	327	2,430	528	209	237	339	523
Lead	6.0	0.91	3.1	2.0		1.2	11.6	0.66	1.4/1.9	2.5	0.75	4.6	0.87		1.7	33.8	31.5
Manganese	25.8	4.1	8.7	28.3			15.8	11.9	3.4/9.5	8.2		15.1	4.0		4.1	6.1	8.9
Mercury	0.06															0.12	0.06
Selenium	2.6																
Silver				9.0	2.3											13.1	9.5
Thallium	4.8								0.18/5.2								
Zinc	10.1			6.1			7.3			4.2		7.5				276	131
pH	9.00	6.75	7.20	9.00	5.05	6.35	8.35	8.50	8.70/8.75	8.90	8.90	8.25	9.70	10.00	7.70	7.90	8.15
Cyanide (mg/kg)																1.8	10.0
Volatile Organic Compounds (mg/kg)																	
Acetone	0.040			0.025		0.019		0.031					0.012			0.057	0.033
Toluene																	0.012
Trichloroethene																	0.042 (0.026)
2-Butanone																	0.015
Semi-Volatile Organic Compounds (mg/kg)																	
bis (2-ethylhexyl) Phthalate																0.160	7.000

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Soil Sampling Results

	V1-1	V2-1	V2-2	V3-1	V3-2	S1-1	S2-1	S3-1	N1-1	N1-2	N1-3	N2-1	N2-2
Metals (mg/kg)													
Aluminum	1,370	1,100	634	1,590	709	261	404	410	1,040	438/1,610	1,500	7,300	178
Arsenic												3.7	
Barium				50.0									
Cadmium	1.9		1.8	30.8	7.9		15.6		57.6	147/74.3		4.2	10.8
Calcium	1,810	8,880	16,900	11,900	31,400	4,810	5,410	11,900		854/1,410		12,000	
Chromium	19.8	6.0	24.3	155	77.1		46.0	4.5	585	2,940/1,200	1,340	28.0	178
Cobalt	32.0								28.6	12.7/21.6		20.4	
Copper		7.3		99.4	47.3		14.9		116	126/173			22.2
Iron	3,810	931	1,040	12,100	1,270	298	2,120	1,150	1,240	434/2,010	291	9,580	181
Lead	33.4	151	28.0	442	73.8	2.2	85.3	8.7	4.0	2.4/3.0	2.5	18.0	1.7
Magnesium												1,540	
Manganese	32.9	27.6	11.9	113	13.6	4.6	10.4	8.3	13.8	8.3/17.5	8.1	36.9	9.4
Mercury		0.61	0.91	0.58	0.19								0.05
Nickel			32.7	90.0	10.3					2.4/11.5			
Silver	2.8			7.1			25.7		65.4	5.9/117			118
Vanadium												15.8	
Zinc	10.4	55.6	19.0	297	42.2		13.7		15.1	80.4/18.2		20.1	
pH	7.65	8.30	8.45	8.20	8.50	9.60	10.80	10.80	8.25	6.95/7.05	6.70	8.40	6.65
Cyanide (mg/kg)							1.8				5.2		
Volatile Organic Compounds (mg/kg)													
Acetone	0.033					0.021		0.049	0.083	0.026/ND	0.022	0.047	
4-Methyl-2-Pentanone							0.053						
Toluene						0.034	0.052			ND/0.014			
Xylene (total)						0.014	0.370						
Ethylbenzene							0.095						

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	V1-1	V2-1	V2-2	V3-1	V3-2	S1-1	S2-1	S3-1	N1-1	N1-2	N1-3	N2-1	N2-2
Chlorobenzene											0.026		
2-Butanone	0.018												
Semi-Volatile Organic Compounds (mg/kg)													
Fluoranthene			1.400	4.200	0.960							0.860	
Pyrene			2.200	2.900	1.300							0.900	
Chrysene			1.900	2.800	0.790							0.610	
Benzo (b) fluoranthene			2.900	2.800	1.200							0.840	
Benzo (a) pyrene	0.370		1.400	1.600	0.510							0.390	
bis (2-ethylhexyl) Phthalate				3.000									
Di-n-octyl Phthalate						1.400							
Benzo (a) Anthracene			1.500	1.800	0.600							0.540	
1,2-Dichlorobenzene										ND/1.300			
Dibenzofuran				0.120									
Fluorene				0.160									
Anthracene				0.310									
Carbazole				0.490									
Phenanthrene				2.600	0.800							0.570	
Acenaphthene				0.270									
Indeno (1 2 3-cd) pyrene			0.720	1.200	0.420								
Benzo (g h i) perylene			0.750	1.100	0.520								